Goldschmidt 2021 Abstract
https://doi.org/10.7185/gold2021.4284

High $^{3}He/^{4}He$ ratios in pore fluids at the outer slope of the Japan Trench

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Geochemical characteristics of pore fluids may reflect geochemical cycles associated with physicochemical processes at convergent plate boundaries such as fault-bending and petit-spot volcanism, which may be related to evolution of the Earth's deep and surface reservoirs through plate subduction processes. For investigation of fluid origins and cycles, ^{3}He is one of the most useful tracers because of its chemical inertness and high sensitivity for mantle-derived components.

In order to investigate origin of fluids at the outer slope of the Japan Trench, we collected sediment and seawater samples at the off Sanriku region during the KH-20-8 cruise onboard R/V Hakuho Maru conducted in August 2020. Using the multi-corer system, sediment and bottom seawater samples were collected at three sites which were close to faults. The obtained samples were immediately transferred into copper tubes and both ends were sealed by metal clamps on the ship in order to avoid air contamination. Subsequent sample preparation and analyses were conducted in Atmosphere and Ocean Research Institute, University of Tokyo. Pore fluids were extracted from the sediment by centrifugation. Then gases dissolved in the pore fluid and seawater samples were extracted and introduced into the vacuum line connected to a QMS and a noble gas mass spectrometer (Helix SFT). In the line, the sample gases were purified and $^{4}He/^{20}Ne$ ratios were measured with the QMS, and $^{3}He/^{4}He$ ratios were measured with Helix SFT. The obtained ratios were calibrated against those of atmosphere standard. At three sites in the off Sanriku region, vertical profiles of $^{3}He/^{4}He$ ratios in pore fluid and seawater samples indicated existence of deep fluid end-members with $^{3}He/^{4}He$ ratios apparently higher than atmosphere. This may reflect migration of mantle-derived volatiles from the deep reservoir to the ocean. In the future, by comparing the obtained data with other geophysical/geochemical datasets, more information of fluid cycles at convergent plate boundaries will be provided, which may be important for investigating evolution of Earth's reservoirs.